EFFICIENCY AND QUALITY

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INCREASING THE EFFICIENCY OF DIAMOND EDGING OF FLAT GLASS

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Increasing grinding efficiency by optimizing binder hardness and using stronger diamond powders at optimal concentration to decrease diamond grinding wheel usage is examined. The new grinding wheels which have a binder with HB100-105 hardness and AS50 – AS65 diamond powder at concentration 62.5% are recommended for industrial use.

Key words: diamond grinding wheel, diamond powder, metal binder, flat-glass edge, surface roughness.

In the Russian Federation, the demand for diamond grinding wheels for manufacturing articles from flat glass is continually increasing. This is due to the mass production of window frames in modern buildings that is based on glass packages as well as greater use of flat glass in commercial construction and furniture manufacturing. For example, more than 1000 companies in the Russian Federation are now producing glass packages. Edging is the most labor-intensive technological operation in the manufacture of articles from flat glass. Consequently, increasing the efficiency of diamond edging of flat glass is an important problem.

The edging efficiency for flat glass was increased by decreasing the relative usage of diamond grinding wheels. This was accomplished by optimizing the binder hardness and using stronger diamond powders at optimal concentration.

The method specified in GOST 16181–82 was used to perform the present investigations employing a V3-318E multipurpose tool grinder with hydraulic longitudinal feed. The grinding was performed using metal bond wheels of the form 1A1 100×6×5×90×32 with binder hardness HRB85-110 and diamond powder concentration 50 – 125%. Using water as the coolant, the lateral edge of 150 × 100 × 4 mm window glass was ground with velocity 25 m/sec, feed rate 1000 mm/min, and grinding depth 1 mm. The relative diamond usage was determined in accordance with GOST 16181–82 by weighing on VLT-1-1 balances. Each experiment was repeated at least five times in order to obtain an average value.

The wheels were made using AS20 – AS65 diamond powder (GOST 9206–80) with fineness 90/70 μm and no coating. The strength of the diamond grains was determined in accordance with GOST 9206–80 on a DA-2M machine, developed at the Institute for Superhard Materials of the Academy of Sciences of Ukraine [1]. A diamond grain was placed between parallel corundum plates and compressed uniaxially with an evenly increasing load. The force at which failure occurred was recorded. One hundred grains were subjected to failure to determine an average value. The shape factor of the diamond powders was monitored on a Video-Test apparatus using the method described in [2]. The results were analyzed in a semiautomatic regime using projections of the grains onto a computer monitor screen. The shape factor was determined from measurements performed on at least 100 grains.

The effect of the binder hardness and strength and concentration of the diamond powder on the roughness of the worked surface of a flat-glass edge was monitored. The roughness was measured with the model 201 profilograph – profilometer manufactured by the Kalibr Company. The purpose of these measurements was to ensure that any relative diamond usage reduction due to optimization of the parameters of the grinding wheel would not increase the roughness of the worked surface of the flat-glass edge.

The dependence of the relative diamond usage on the binder hardness at 50% concentration of AS50 diamond powder (Fig. 1) was constructed to determine the optical binder hardness of the diamond wheel. The binder hardness was increased by changing the copper/tin ratio. It was determined that metal binders with hardness HB100-105 decrease the relative diamond usage by 30 – 35% compared with the M2-01 binder with hardness HB85-95. Increasing the binder hardness to HB110 did not decrease the relative diamond

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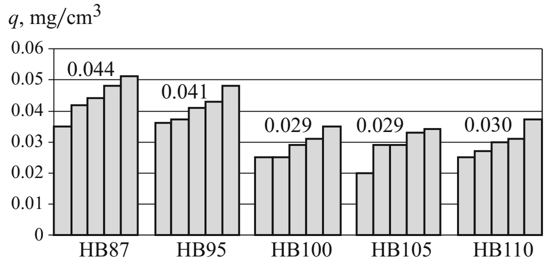

Fig. 1. Relative diamond usage q versus the hardness of the metal binder (AS50 diamond powder with concentration 50%).

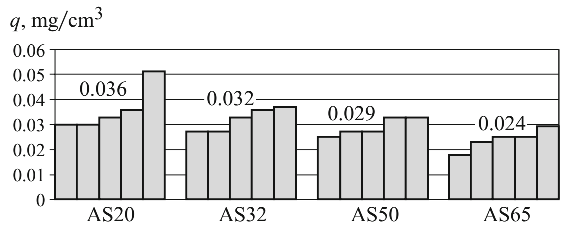

Fig. 2. Relative diamond usage q versus the brand of diamond powder: the powder concentration is 50% concentration and binder hardness is HB100-105.

usage. Thus, it is best to use a binder with hardness HB100-105 to increase the efficiency of diamond edging of flat glass.

The desirability of using stronger diamond powders was checked in order to increase the edging efficiency for flat glass in accordance with the recommendations of [3, 4]. For this, the dependence of the relative diamond usage on the brand of the diamond powder with 50% concentration in a binder with hardness HB100-105 was constructed (Fig. 2). Analysis of the results showed that using the stronger diamond powders AS50 – AS65 instead of AS20 – AS32 increases by 25 – 35% the service life of the wheels used for edging flat glass.

The dependence of the relative diamond usage on the concentration of AS65 diamond powder in a binder with hardness HB100-105 was constructed to determine the optimal diamond powder concentration in a diamond wheel (Fig. 3). The optimal diamond powder concentration for edging flat glass is 62%, which decreases relative diamond usage by 10 – 15%. The results obtained for the optimal concentration are essentially identical to the data provided by the leading world manufacturers of diamond wheels with powder concentration 62.5% for this technological operation.

The surface roughness R_a of the edge of glass ground using the diamond powders AS20 – AS65 at concentration 50 – 100% with binder hardness HB85 – HB110 was measured. In the range studied, these factors did have a large effect on the roughness of the ground surface, which fluctuated in the range 1.3 – 1.5 μm.

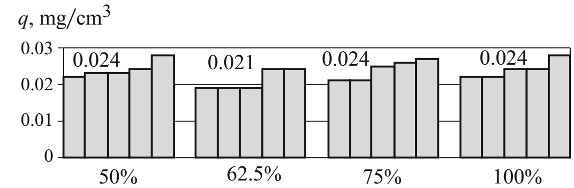

Fig. 3. Relative diamond usage q versus the concentration of AS65 diamond powder (binder hardness HB100-105).

As a result of these investigations, new wheels having a binder with hardness HB100-105 and diamond powder AS50 – AS65 at concentration 62.5% were recommended for industrial use. Fifteen firms in the Czech Republic and Slovakia are now successfully using the new wheels for edging flat glass.

Thus, the new metal binder with hardness HB100-105 decreases relative diamond usage by 30 – 35% as compared with the M2-01 binder with hardness HB85-95.

The stronger diamond powders AS50 – AS65 increase the service life of wheels used for edging flat glass by 25 – 35% as compared with the AS20 – AS32 powders.

It is recommended that diamond powder with optimal concentration 62.5% be used to manufacture wheels for machine grinding. This will decrease the relative diamond usage by 10 – 15%.

Changing the binder hardness (HB85 – HB110) or the hardness (AS20 – AS65) or concentration (50 – 100%) of the diamond powder does not greatly affect the roughness of the worked surface, which is 1.3 – 1.5 μm for diamond powder fineness 90/75 μm.

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